Claims:

1. (Currently Amended) A process for the production ~~hydrogenation~~ of [[a]] an hydrogenated polymer comprising the steps of:

~~providing~~ polymerizing monomer in an appropriate solvent to create a polymer cement in a polymerization reactor, wherein the ~~solution of at least one~~ polymer cement so produced includes unsaturated polymer ~~in at least one solvent~~;

removing the polymer cement from the polymerization reactor, wherein the polymer cement has a polymerization temperature above ambient temperature due to the heat of polymerization;

adding the polymer cement removed from the polymerization reactor into a hydrogenation reactor;

~~metering~~ adding hydrogen gas and an hydrogenation catalyst solution into the polymer cement ~~solution~~ to create a reaction mixture;

pressurizing and heating the reaction mixture in the polymerization reactor such that the contents of the reaction mixture exist in the supercritical phase; and

hydrogenating said at least one polymer while the contents of the reaction mixture are in the supercritical phase.

2. (Currently Amended) A process for the hydrogenation of a polymer comprising the steps of:

determining the critical temperature and critical pressure for a mixture of hydrogen, at least one polymer, and at least one appropriate solvent for the at least one polymer wherein said step of determining includes process steps selected from the group consisting of:

(a)(i) mixing hydrogen and the at least one appropriate solvent at a given ratio,

(a)(ii) determining the critical point for the mixture of step (a)(i), and

(a)(iii) repeating said steps (a)(i) and (a)(ii) for a plurality of hydrogen to solvent ratios; and

(b)(i) dissolving the at least one polymer in the at least one appropriate solvent,

(b)(ii) adding hydrogen to a portion of the solution resulting in step (b)(i),

(b)(iii) determining the critical point for the mixture resulting in step (b)(ii), and

(b)(iv) repeating steps (b)(ii) and (b)(iii) for different weight fractions of hydrogen in the polymer solution of step (b)(i);

providing a polymer solution of the at least one polymer in the at least one appropriate solvent;

metering~~, the~~ hydrogen gas and an hydrogenation catalyst solution into said polymer solution, to create a reaction mixture;

pressurizing and heating the reaction mixture to meet or exceed ~~the determined~~ an appropriate critical pressure and ~~determined~~ critical temperature for the reaction mixture, as determined in ~~of~~ said step of determining; and

hydrogenating the at least one polymer at or above the determined critical pressure and determined critical temperature.

3. (Withdrawn) An apparatus for the hydrogenation of a polymer comprising:

a tubular coil reactor installed in a pressure vessel that is partly filled with a heat sink fluid to cover at least a portion of said tubular coil reactor;

a pump metering polymer solution, hydrogen, and hydrogenation catalyst solution to said tubular coil reactor to provide a reaction mixture in said tubular coil reactor, said tubular coil reactor being maintained at a temperature and pressure sufficient to place the contents of said reaction mixture in the supercritical phase; and

a condenser communicating with said pressure vessel to receive vapor from the heat sink fluid and convert it back to heat sink fluid liquid, and return the heat sink fluid liquid back to said pressure vessel.

4. (Withdrawn) An apparatus for the hydrogenation of a polymer at or above a determined supercritical temperature and determined supercritical pressure comprising:

a source of a polymer solution;

a source of hydrogen;

a source of an hydrogenation catalyst solution;

a tubular coil reactor installed in a pressure vessel that is partly filled with a heat sink fluid to cover at least a portion of said tubular coil reactor, wherein said heat sink fluid is heated to near the determined supercritical temperature, and its saturation pressure is established, in the pressure vessel, such that the vapor phase of said heat sink fluid present in said pressure vessel is in equilibrium with the liquid phase of said heat sink fluid;

a pump metering polymer solution, hydrogen, and hydrogenation catalyst solution, from their respective sources, to said tubular coil reactor, at or above the determined supercritical pressure; and

a condenser communicating with said pressure vessel to receive heat sink fluid vapor and convert it back to heat sink fluid liquid, and return the heat sink fluid liquid back to said pressure vessel.

5. (New) The process of claim 1, further comprising the step of determining the critical temperature and the critical pressure for a mixture of hydrogen, at least one polymer, and at least one appropriate solvent for the at least one polymer, wherein the critical temperature and critical pressure determined from this step are employed in said step of pressurizing and heating the reaction mixture in the polymerization reactor.

6. (New) The process of claim 5, wherein said step of determining includes process steps selected from the group consisting of:

(a)(i) mixing hydrogen and the at least one appropriate solvent at a given ratio,

(a)(ii) determining the critical point for the mixture of step (a)(i), and

(a)(iii) repeating said steps (a)(i) and (a)(ii) for a plurality of hydrogen to solvent ratios; and

(b)(i) dissolving the at least one polymer in the at least one appropriate solvent,

(b)(ii) adding hydrogen to a portion of the solution resulting in step (b)(i),

(b)(iii) determining the critical point for the mixture resulting in step (b)(ii), and

(b)(iv) repeating steps (b)(ii) and (b)(iii) for different weight fractions of hydrogen in the polymer solution of step (b)(i).